DOCUMENT RESUME

ED 269 230 SE 046 544

AUTHOR Schibeci, Renato; And Others
TITLE Effects of Classroom Environment on Science Attitudes: A Crosscultural Replication in Indonesia.
PUB DATE 86
NOTE 27p.; Paper presented at a symposium "Research on Crosscultural Replication in Indonesia. Association for Research in Science Teaching (59th, San Francisco, CA, March 28-April 1, 1986). For related documents, see SE 046 542-543.
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Biology; *Classroom Environment; *Cross Cultural Studies; Developing Nations; Foreign Countries; Science Education; Secondary Education; *Secondary School Science; *Student Attitudes
IDENTIFIERS *Indonesia; Science Education Research

ABSTRACT

A three-phase study, with a different sample for each phase, involved a total of 1125 secondary school students in Indonesia. The first phase involving 373 grade 8 and 9 students was used to develop and validate an Indonesian classroom environment instrument with eight scales based on the Individualized Classroom Environment Questionnaire and the Classroom Environment Scale. In the second phase of the study, 502 Indonesian science students in grades 11 and 12 were involved in a translation, adaptation, and validation of a four-scale Indonesian version of the Test of Science-Related Attitudes. In the third phase, these new Indonesian attitude and environment scales were used with another sample of 250 Indonesian biology students in an investigation of the effects of classroom psychosocial environment on students' science-related attitudes. The finding of statistically significant associations between environment and attitudes replicated much prior work in science classrooms in developed countries. For example, more favorable science-related attitudes on several scales were found in classes perceived as having more personalization, participation, investigation, order, and organization. (Author)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☑ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ED269230

EFFECTS OF CLASSROOM ENVIRONMENT ON SCIENCE ATTITUDES: A CROSSCULTURAL REPLICATION IN INDONESIA

RENATO A. SCHIBECI
Murdoch University
Murdoch, Western Australia 6150

I. MADE RIDENG
FKIP UNUD Singaraja
Jln. Akhmad Yani 67
Singaraja, Bali, Indonesia

BARRY J. FRASER
Western Australian Institute of Technology
Bentley, Western Australia 6102

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Barry Fraser
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

SE046 544

Paper presented as part of symposium entitled "Research on Classroom and School Environment" at Annual Meeting of National Association for Research in Science Teaching, San Francisco, March 1986

ABSTRACT

A three-phase study, with a different sample for each phase, involved a total of 1125 secondary school students in Indonesia. The first phase involving 373 Grade 8 and 9 students was used to develop and validate an Indonesian classroom environment instrument with eight scales based on the Individualized Classroom Environment Questionnaire and the Classroom Environment Scale. In the second phase of the study, 502 Indonesian science students in Grades 11 and 12 were involved in a translation, adaptation and validation of a four-scale Indonesian version of the Test of Science-Related Attitudes. In the third phase, these new Indonesian attitude and environment scales were used with another sample of 250 Indonesian biology students in an investigation of the effects of classroom psychosocial environment on students' science-related attitudes. The finding of statistically significant associations between environment and attitudes replicated much prior work in science classrooms in developed countries. For example, more favourable science-related attitudes on several scales were found in classes perceived as having more personalization, participation, investigation, and order and organization.

INTRODUCTION

In developed countries, quite extensive work has been completed by now on the assessment and investigation of students' perceptions of the psychosocial environment of both science and non-science classes (Fraser, 1985, 1986a; Fraser & Walberg, 1981). In contrast, analogous classroom environment research has hardly begun in developing countries. The main purpose of the present research in Indonesia was to investigate the effects of classroom environment on students' attitudes to science. A secondary outcome of the research was that it led to the development and validation of the first instruments available in the Indonesian language for assessing classroom environment and science-related attitudes.

The research consisted of three separate phases which each involved a separate sample of Indonesian students. Table 1 provides some descriptive information about the samples and shows that, of a total of 1125 Indonesian students, 373 were involved in the development of the classroom environment instrument, 502 were involved in the development of the science-related attitude instrument, and 250 were involved in the investigation of the effects of classroom environment on student attitudes.

Discussion in this paper is organized into four major sections. First, in order to place the present study into context, past research on classroom environment is briefly reviewed. Second, the development and validation of the Indonesian classroom environment instrument is described. Third, the development and validation of the Indonesian science attitude instrument is considered. Fourth, the investigation of the effects of classroom environment on student attitudes is reported.

PAST RESEARCH ON CLASSROOM ENVIRONMENT

Overview of Lines of Research

Existing reviews of international efforts in measuring and researching perceptions of classroom psychosocial environment in developed countries (Moos, 1979; Walberg, 1976, 1979; Fraser, 1981a, 1985, 1986a; Chavez, 1984) show what an active field of study it has been. These publications, together with Fraser and Walberg's (1981) review focusing specifically on science education, indicates that a sizable proportion of the past research work on classroom environment has involved science classes. These reviews also show that the instruments used most extensively in past classroom environment research in science education are the Learning Environment Inventory (Anderson & Walberg, 1974; Fisher & Fraser, 1981; Fraser, Anderson & Walberg, 1982), the Classroom Environment Scale (Moos & Trickett, 1974; Fisher & Fraser, 1983a) and the Individualized Classroom Environment Questionnaire (Rentoul & Fraser, 1979; Fraser, 1986b). These instruments can be used to tap perceptions of either actual or preferred classroom climate among students or teachers.

When used as criterion variables, classroom environment dimensions provide important process criteria of curricular effectiveness (Fraser, 1981a). Several studies of alternative science curricula have shown that classroom environment variables have differentiated revealingly among the

TABLE 1. Indonesian Samples Involved in Validation of Instruments and Study of Effects of Environment on Attitudes

Sample	Number of Students	Number of Classes	Grade Level	Purpose of Research
Sample A	373	18	8, 9	Validation of environment scales
Sample B	502	12	11, 12	Validation of attitude scales
Sample C	250	6	11	Crossvalidation and study of effects of environment on attitudes
	1125	36		

curricula when various cognitive outcome measures have shown little sensitivity (Anderson, Walberg & Welch, 1969; Fraser, 1979). Also a series of other studies reviewed by Fraser (1986c) has used classroom environment scales as sources of dependent variables and has established interesting relationships between the nature of the classroom environment and teacher personality (Walberg, 1968), class size (Walberg, 1969a), grade level (Welch, 1979), type of school (Trickett, 1978; Hofstein, Gluzman, Ben-Zvi & Samuel, 1980) and school subject (Anderson, 1971; Kuert, 1979).

Several classroom environment instruments have different forms which can be used in investigating differences between student and teacher perceptions of the same actual classroom environment, and of discrepancies between the actual environment and that preferred by students. These questions have been explored using the CES in the U.S. (Moos, 1979) and Australia (Fisher & Fraser, 1983b), the ICEQ in Australia (Fraser, 1982) and the MCI in Australia (Fraser, 1984). These studies provide two patterns of consistent and interesting results: first, students tended to prefer a more favourable classroom environment than they perceived as being actually present; and second, teachers tended to perceive the classroom environment more favourably than did their students in the same classroom. The practical importance of these findings for teachers is that they should expect commonly to find that their own perceptions of the classroom environment differ from those of their students, and that the actual classroom environment often falls short of that preferred by students.

Prior research often has focused on relationships between student learning outcomes and their perceptions of actual classroom environment. However, by assessing both actual and preferred environment, it is possible to investigate whether students achieve better when in their preferred environment. Fraser and Fisher (1983b) compared the achievement of science students who do prefer classroom individualization with those who do not prefer individualization, when in classrooms with various levels of actual individualization. Evidence suggested that higher actual individualization was associated with higher learning levels only among those students who preferred individualization; it tended to retard learning among students with opposite preferences. The important practical implication from this research is that students are likely to achieve better in classrooms in which there is similarity between the actual environment and that preferred by students.

It is highly desirable that the recent emphasis on research on classroom environment should have some practical application in facilitating improvements in classrooms. A suggested approach described by Fraser (1981b) involves, first, administering a classroom environment instrument twice (once to assess actual environment and once to assess preferred environment), second, identifying discrepancies between the actual environment and that preferred by students, third, implementing classroom strategies aimed at aligning the actual environment more closely with students' preferred environment, and, fourth, readministering the climate scales in order to determine the extent to which attempts at environmental improvement were successful. It is noteworthy that recent applications of this strategy in science classes have supported the effectiveness of the strategy and attested to the potential usefulness of

employing classroom environment instruments to provide science teachers with meaningful information about problem areas and a tangible basis to guide improvements in these areas (Fraser & Fisher, 1986).

The strongest tradition in prior classroom environment research in both science and non-science classes has involved investigation of relationships between student perceptions of the classroom environment and their achievement of cognitive, affective and psychomotor outcomes. This extensive collection of studies is described in recent reviews (Fraser, 1985, 1986a) and is considered in more detail in the next section.

Studies of Outcome-Environment Associations

Overall, the body of research on the effects of environment on outcomes provides much consistent evidence indicating that classroom environment dimensions are related to student outcomes , even when student characteristics such as pretest performance and IQ are controlled. Moreover, this pattern is illustrated in the consistent findings of Haertel, Walberg and Haertel's (1981) meta-analysis of 12 studies of environment-outcome relationships involving 17,805 students in four nations. Student learning was found consistently to be positively related to the levels of cohesiveness, satisfaction and task orientation in the classroom, and negatively related to levels of friction and disorganization. These findings have important practical implications about the ways in which classrooms might be changed in an attempt to improve student learning.

Table 2 provides a convenient summary of the prior studies of outcome-environment associations which specifically involved science classes. This table lists for each study details of the classroom environment instrument used, the outcome measures involved and the sample. It is clear from this table that evidence supporting the predictive validity of students' classroom environment perceptions comes from studies using several different environment instruments, a range of outcome measures and samples spanning numerous countries and grade levels.

Only two of the studies listed in Table 2 were conducted in developing countries. These investigations involved the translation and adaptation of English versions of some existing classroom environment scales and their use in investigating associations between students' outcomes and their classroom environment perceptions.

Walberg, Singh and Rasher's (1977) study in India involved administration of the 15 Learning Environment Inventory scales translated into Hindi to a random sample of 3,000 tenth grade students in 83 science and 67 social science classes in 26 districts of the State of Rajasthan. The unit of statistical analysis employed was the mean score of the subgroup within the class formed by grouping studious class members together and non-studious class members together. Therefore the total sample size was 166 science subgroups (83 studious and 83 non-studious) and 134 social science subgroups (67 studious and 67 non-studious). Strong and statistically significant associations between cognitive achievement and student-perceived classroom environment were found.

TABLE 2. Details of Studies of Associations Between Student Outcomes and Classroom Environment

Study	Outcome Measures	Sample
Studies Involving LEI		
Anderson & Walberg (1968); Walberg & Anderson (1968); Anderson (1970); Walberg (1969b, c, 1972)	Selected from: achievement; understanding of nature of science; science processes; participation in physics activities; science interest; attitudes	Various samples (maximum of 144 classes) of senior high school physics students mainly in USA, but with some in Canada
Walberg & Anderson (1972)	Examination results	1,600 Grade 10 and 11 students in 64 classes in Montreal, Canada
Lawrenz (1976)	Science attitudes	238 senior high school science classes in midwest USA
Fraser (1978b, 1979)	Inquiry skills; attitudes; understanding of nature of science	531 students in 20 Grade 7 science classes in Melbourne, Australia
Power & Tisher (1979)	Achievement; attitudes; satisfaction	315 junior high school students in 20 classes in Melbourne, Australia
Hofstein et al. (1979)	Attitudes	400 Grade 11 students in 12 chemistry classes in Israel
Haladyna, Olsen & Shaughnessy (1982)	Attitudes	5,804 science, mathematics and social studies students in 277 Grade 4, 7 and 9 classes in Oregon, USA
Studies Involving CES		
Fisher & Fraser (1983c)	Inquiry skills; attitudes	116 Grade 8 and 9 science classes throughout Tasmania, Australia

Study	Outcome Measures	Sample
Studies Involving ICEQ		
Rentoul & Fraser (1980)	Inquiry skills; enjoyment	285 junior high school students in 15 classes in Sydney, Australia
Wierstra (1984)	Attitudes; achievement	398 15-16 year-old students in 9 classes in the Netherlands
Fraser (1981c); Fraser & Butts (1982)	Attitudes	Maximum of 712 students in 30 junior high school science classes in Sydney, Australia
Fraser, Nash & Fisher (1983)	Anxiety	116 Grade 8 and 9 science classes throughout Tasmania, Australia
Fraser & Fisher (1982a)	Inquiry skills; attitudes	116 Grade 8 and 9 science classes throughout Tasmania, Australia
Studies Involving MCI		
Fraser & Fisher (1982b)	Inquiry skills; understanding of nature of science; attitudes	2,305 Grade 7 science students in 100 classes in Tasmania, Australia
Studies Involving Other Instruments		
Kelly (1980)	Achievement	41,657 students in 1,735 schools in 14 developed countries involved in an IEA science study
Talton (1983)	Attitude; achievement	1,456 Grade 10 biology students in 70 classes in 4 schools in North Carolina
Gardner (1976)	Attitudes	1,014 Grade 11 physics students in 58 classses in Melbourne, Australia

Study	Outcome Measures	Sample
<u>Studies in Developing Countries</u>		
Walberg, Singh & Rasher (1977)	Achievement	3,000 Grade 10 science and social science students in 150 classes in Rajasthan, India
Chatiyanonda (1978); Fraser (1985d)	Attitudes	989 Grade 12 physics students in 31 classes in or near Bangkok, Thailand

Data reported by Chatiyanonda (1978) were reanalysed by Fraser (1986d) to provide crosscultural data on the incremental predictive validity of students' environment perceptions in Thailand. The sample consisted of 989 twelfth grade physics students in 31 classes in Bangkok or nearby provinces. Learning environment measured with a Thai version of 10 of the Learning Environment Inventory's scales was used to predict three attitudinal outcomes (attitude to physics learning, enjoyment of physics and attitude to scientists). Simple correlational analysis revealed that half of the correlations between an LEI scale and a posttest score on an attitude scale were significantly different from zero at the 0.05 level of confidence, which is 10 times that expected by chance. Multiple regression analyses revealed that the increment in posttest attitude variance accounted for by the set of environment scales (beyond that attributable to corresponding beginning-of-year attitude scores and numerous background variables) was significant for two of the three attitude scales. More favourable attitudes to physics learning were expressed in classes perceived as having more cohesiveness, less friction, less cliqueness and more satisfaction, while greater enjoyment of physics was reported in classrooms characterized as having less speed, more satisfaction, less disorganization and greater competitiveness.

Although not involving science students specifically, a number of other interesting studies in various developing countries have led to the establishment of links between classroom environment and student outcomes. These studies are Paige's (1978) and Fraser, Pearse and Azmi's (1982) research in Indonesia, Persaud's (1976) research in Jamaica and Holsinger's (1972) investigation in Brazil.

ASSESSMENT OF CLASSROOM ENVIRONMENT IN INDONESIA

Development of Environment Scales

The Indonesian instrument for assessing classroom psychosocial environment was based on the Individualized Classroom Environment Questionnaire (Rentoul & Fraser, 1979; Fraser, 1986b) and the Classroom Environment Scale (Moos & Trickett, 1974; Fisher & Fraser, 1983a). The first step in developing the classroom environment instrument was the translation into Indonesian of all items contained in the 14 scales in the English versions of the ICEQ and CES. These translations were carried out collaboratively by a group of Indonesian postgraduate students working in Australia and some Australian and Indonesian academics fluent in both English and Indonesian. In particular, the accuracy of the Indonesian translations was checked by some Indonesians working as English lecturers at the Institute of Teacher Education in Padang and by obtaining independent translations back into English. Also a preliminary translated version was tried out with a small group of Indonesian school students prior to settling on a final version of the instrument (Fraser, Pearse & Azmi, 1982).

Further refining of the first translated version of the instrument was based on the results of several item analyses performed with data obtained by administering the 14 translated scales to a sample of students in Indonesia. In particular, the internal consistency of each scale was maximized by selecting items with large item-scale correlations and discriminant validity was enhanced by including only those items whose correlation with its a priori assigned scale was smaller than its

correlation with any other scale in the test battery. Application of these criteria led to the decision to delete altogether six of the original scales because of low reliability, and to reduce the number of items in each of the remaining nine scales from 10 to seven items to optimize scale statistics. Consequently, the present investigation was based on an Indonesian instrument which had seven items assessing each of eight scales.

Table 3 clarifies the nature of the Indonesian classroom environment by providing a scale description and sample item for each scale. The first five scales listed in Table 3 correspond to the Individualized Classroom Environment Questionnaire's five scales, whereas the other three scales correspond to three of the nine scales in the English version of the Classroom Environment Scale.

Validation of Environment Scales

Validation data were generated for the classroom environment instrument for two separate samples of Indonesian students. The first sample (identified as Sample A in Table 1) consisted of 373 students in 18 classes (nine in Grade 8 and nine in Grade 9) in Padang, the capital of West Sumatra. Data were collected from all students at the Grade 8 and 9 levels studying social science in the 18 classes at the nine junior high schools of the Department of Education in Padang, but for economy only a random half of the students from each class was included in the data analyses. Each class was coeducational and approximately equal numbers of boys and girls made up the total sample. All questionnaires were administered during normal class time by a researcher who gave comparable instructions for responding and assured students of the confidentiality of their responses. The second sample (Sample C in Table 1) consisted of the 250 Grade 11 biology students in six classes involved in the investigation of the effects of classroom environment on attitudes. Whereas Sample A responded only to the actual form of the scales, Sample C provided data for both the actual and preferred forms of the instrument.

Table 4 presents three types of validity data which should enhance confidence in the use of the new instrument among researchers and teachers in Indonesia. For both samples, this table provides information about the actual form of each scale's internal consistency (alpha reliability), discriminant validity (using the mean correlation of a scale with the remaining seven scales as a convenient index) and ability to differentiate between the perceptions of students in different classrooms. As well, Table 2 provides analogous internal consistency and discriminant validity information for Sample C for the preferred form of each scale. Because gains in test validity statistics obtained through item analysis can be lost in subsequent administrations of an instrument, it is highly desirable that validity information generated with the sample involved in test development be supplemented as in Table 4 with crossvalidation information based upon a second independent sample.

Table 4 indicates that the alpha coefficients for the nine classroom environment scales ranged from 0.56 to 0.73 for the actual form for Sample A, from 0.46 to 0.80 for the actual form for Sample C, and from 0.42 to 0.75 for the preferred form for Sample C. Although these values typically are a little smaller than for Australian samples (see Fraser & Fisher, 1983a), they are large enough to suggest that the Indonesian version of each scale possesses adequate internal consistency. Table 4

TABLE 3. Scale Description and Sample Item for each Scale in Indonesian Classroom Environment Instrument

Scale Name	Description of Scale	Sample Item
Personalization	Emphasis on opportunities for individual students to interact with the teacher and on concern for the personal welfare and social growth of the individual.	The teacher considers students' feelings. (a)
Participation	Extent to which students are encouraged to participate rather than be passive listeners.	There is classroom discussion. (a)
Independence	Extent to which students are allowed to make decisions and have control over their own learning and behaviour.	Students are told exactly how to do their work. (b)
Investigation	Emphasis on the skills and processes of inquiry and their use in problem-solving and investigation.	Students carry out investigations to test ideas. (a)
Differentiation	Emphasis on the selective treatment of students on the basis of ability, learning style, interests and rate of working.	All students in the class do the same work at the same time. (b)
Involvement	Extent to which students have attentive interest, participate in discussions, do additional work and enjoy the class.	Students daydream a lot in this class. (c)
Affiliation	Extent to which students help each other, get to know each other easily and enjoy working together.	Students in this class get to know each other really well. (d)
Order and Organization	Emphasis on students behaving in an orderly, quiet and polite manner, and on the overall organization of classroom activities.	Assignments are usually clear so that everyone knows what to do. (d)

Items designated (a) are scored 1, 2, 3, 4, 5, respectively, for the responses Almost Never, Seldom, Sometimes, Often, Very Often. Items designated (b) are scored in the reverse manner. Items designated (c) are scored 1 and 3, respectively, for the responses of True and False. Items designated (d) are scored in the reverse manner.

TABLE 4. Internal Consistency (Alpha Reliability), Discriminant Validity (Mean Correlation of Scale with Other Seven Scales) and ANOVA Results for Ability to Differentiate Between Classrooms for Indonesian Classroom Environment Instrument

Scale	Form	Alpha Reliability		Mean Correlation With Other Scales		ANOVA Results for Class Membership Differences	
		Sample A N=373	Sample C N=250	Sample A N=373	Sample C N=250	Sample A N=373	Sample C N=250
Personalization	Actual	0.65	0.62	0.32	0.29	0.12*	0 13*
	Pref		0.54		0.30		
Participation	Actual	0.73	0.80	0.33	0.35	0.21*	0.17*
	Pref		0.67		0.31		
Independence	Actual	0.61	0.61	0.21	0.20	0.11*	0.17*
	Pref		0.60		0.18		
Investigation	Actual	0.64	0.73	0.26	0.29	0.10*	0.08*
	Pref		0.75		0 28		
Differentiation	Actual	0.57	0.46	0.11	0.08	0.15*	0.16*
	Pref		0.42		0.12		
Involvement	Actual	0.60	0.64	0.29	0.28	0.11*	0.14*
	Pref		0.51		0.30		
Affiliation	Actual	0.56	0.54	0.22	0.15	0.10*	0.06*
	Pref		0.42		0.19		
Order and Organization	Actual	0.64	0.76	0.32	0.28	0.16*	0.33*
	Pref		0.65		0.29		

* $p<0.01$

shows that the mean correlation of an environment scale with the other eight scales ranged from 0.11 to 0.33 for the actual form for Sample A, from 0.08 to 0.35 for the actual form for Sample C, and from 0.12 to 0.31 for the preferred form for Sample C. These values are comparable to those obtained for samples in Australia (Fraser & Fisher, 1983a), and they suggest that both the Indonesian and English versions of these scales measure distinct although somewhat overlapping aspects of classroom environment.

Another desirable characteristic of the actual form of any classroom environment scale is that it is capable of differentiating between the perceptions of students in different classes. That is, students within the same class should perceive it relatively similarly, while mean within-class perceptions should vary from class to class. This was explored for each scale for both Samples A and C by performing a one-way ANOVA with class membership as the main effect and using the individual as the unit of statistical analysis. The results of these analyses are shown in Table 4 and indicate that each of the nine scales differentiated significantly ($p<0.01$) between the perceptions of students in different classrooms for both samples. Also the eta^2 statistics, which provides an estimate of the amount of variance in classroom environment scores attributable to class membership, ranged from 0.10 to 0.21 for Sample A and from 0.06 to 0.33 for Sample C.

ASSESSMENT OF ATTITUDES IN INDONESIA

Development of Attitude Scales

As the development of favourable science-related attitudes is stated explicitly as an objective for all Indonesian students from elementary to senior high school (Soedijarto, 1980), it was considered justifiable to use attitude measures as criterion variables in the present study. After examination of numerous science attitude tests, the Test of Science-Related Attitudes (TOSRA; Fraser, 1978a, 1981d) was selected as a suitable basis for developing an attitude instrument for Indonesian science students. Of the seven scales in the English version of TOSRA, only the four listed in Table 5 were chosen for inclusion in the study in Indonesia. This table clarifies the meaning of the attitude scales by providing a sample item for each scale and each scale's classification according to Klopfer's (1971) scheme.

The development of the Indonesian attitude test followed procedures similar to those used in developing the classroom environment instrument. Each item in the English version of TOSRA was screened for suitability in the Indonesian context, and some new items based on stated objectives of the science curriculum in Indonesia were added. The English version of TOSRA was translated into Indonesian and checked by a number of fluent speakers of both English and Indonesian. Because the present study involved biology students specifically, the word "science" was changed to "biology" in each item and the name Test of Biology-Related Attitudes (TOBRA) was used for the new instrument. A panel of judges - consisting of Indonesian biology teachers and staff in education or biology from two Indonesian universities - vetted a preliminary pool of items according to criteria including item clarity, face validity, scale allocation and salience to the attitudinal objectives of the curriculum. Finally, a preliminary version of the

TABLE 5. Sample Item and Classification According to Klopfer's (1971) Scheme for each Attitude Scale

Scale	Sample Item	Klopfer's Classification
Attitude to Scientific Inquiry	Attempting to solve biology problems by doing experiments is a waste of time. (-)	H.2: Acceptance of scientific inquiry as a way of thought
Adoption of Scientific Attitudes	In doing biological experiments, I report unexpected results as well as expected results. (+)	H.3: Adoption of scientific attitudes
Enjoyment of Biology Lessons	I enjoy doing drawings for biology. (+)	H.4: Enjoyment of science learning experiences
Leisure Interest in Biology	I am interested in reading biology articles in science magazines. (+)	H.5: Development of interest in science-related activities

Items designated (+) are scored 5, 4, 2, 1, respectively for the responses Strongly Agree, Agree, Disagree, Strongly Disagree. Items designated (-) are scored in the reverse manner. Omit or invalid responses are scored 3.

instrument containing 68 items was field tested with 288 Grade 10 and 11 students in Indonesia and item analysis procedures were used to evolve a refined instrument with 40 items (i.e., 10 per scale).

The final version was validated with a sample of 502 students in 12 Grade 11 and 12 biology classes in six public senior high schools in Indonesia. This sample is labelled as Sample B in Table 1. Table 6 shows the statistics obtained with Sample B for each scale's internal consistency (alpha reliability), test-retest reliability and discriminant validity (mean correlation of a scale with the other three scales). In addition, Table 6 includes internal consistency and discriminant validity information as crossvalidation data based on Sample C (i.e., the sample used to investigate the effects of classroom environment on attitudes).

Table 6 shows that alpha coefficients ranged from 0.64 to 0.72 for Sample B and from 0.53 to 0.69 for Sample C; test-retest reliabilities ranged from 0.61 to 0.76 for Sample B; and mean correlations of a scale with the other scales were typically around 0.5 for each scale for both samples. These values suggest that TOBRA has adequate reliability but that its scales have a degree of overlap. Nonetheless, it was considered appropriate to maintain four distinct scales in TOBRA both because the scales correspond to the useful conceptual distinctions proposed by Klopfer (1971) and because the same four-factor structure emerged when a group of Indonesian science teachers were asked to categorize the items (Rideng & Schibeci, 1984).

STUDY OF EFFECTS OF CLASSROOM ENVIRONMENT ON ATTITUDES

The major purpose of the present research was the investigation of associations between Indonesian students' science-related attitudes and their perceptions of classroom psychosocial environment. This involved using the data collected for the sample of 250 Indonesian biology students to relate their scores on the four science attitude scales to scores on the eight classroom environment scales.

Table 7 shows the results obtained when outcome-environment relationships were investigated using three different methods of data analysis, namely, simple, multiple and canonical correlation techniques. The first type of analysis is the least complex as it involves simple correlations between the four outcomes and the nine environment dimensions. A major advantage of these simple correlational analyses is that they furnish data to other workers interested in associations between particular environment variables and particular outcomes. The results in Table 7 show that 13 of the 32 simple correlations were statistically significant ($p<0.05$). Moreover, the interpretation of most of these significant correlations was that greater levels of particular environment dimensions were associated with more positive science attitudes. The only exceptions were that high levels of classroom Independence were associated with worse attitudes on the three scales of Adoption of Scientific Attitudes, Enjoyment of Science Lessons and Leisure Interest in Science.

The second type of analysis reported in Table 7 consisted of a multiple correlation analysis involving the set of nine environment scales and performed separately for each of the four attitude outcomes. These multiple correlation analyses provide a more parsimonious picture of the

TABLE 6. Internal Consistency (Alpha Reliability), Test-Retest Reliability and Discriminant Validity (Mean Correlation of Scale with Other Three Scales) for Indonesian Attitude Instrument

Scale	Alpha Reliability		Test-Retest Reliability	Mean Correlation with other Scales	
	Sample B N = 502	Sample C N = 250	Sample B N = 502	Sample B N = 502	Sample C N = 250
Attitude to Inquiry	0.65	0.56	0.70	0.51	0.52
Adoption of Scientific Attitudes *	0.64	0.53	0.61	0.52	0.48
Enjoyment of Biology Classes	0.72	0.68	0.74	0.53	0.55
Leisure Interest in Biology	0.70	0.69	0.76	0.53	0.58

* Each scale has 10 items except Adoption of Scientific Attitudes which has 9 items.

joint influence of correlated environment dimensions on outcomes and reduces the Type I error rate associated with the simple correlational analysis. The multiple correlation was found to be 0.28 ($p<0.05$) for Attitude to Inquiry, 0.34 ($p<0.01$) for Adoption of Scientific Attitudes, 0.34 ($p<0.01$) for Enjoyment of Biology Lessons and 0.37 ($p<0.01$) for Leisure Interest in Biology. Inspection of the beta weights (i.e., the standardized regression weights) in Table 7 shows that there were six cases in which an environment dimension was related significantly to an attitude dimension when the other seven environment scales were held constant. It was found that Attitude to Inquiry scores were higher in classes perceived to have more Order and Organization, Adoption of Scientific Attitude scores were higher in classes perceived to have greater Participation, and Enjoyment of Biology Lessons and Leisure Interest in Biology were greater in classes with more Participation and less Independence.

The last row in Table 7 reports the results of the canonical analysis of the relationship between the four attitudes and the set of eight classroom environment measures. A significant canonical correlation of 0.39 ($p<0.01$) was found. Inspection of canonical loadings indicated that Adoption of Scientific Attitudes and Leisure Interest in Biology scores were higher in classes perceived by students to have more emphasis on Participation and less emphasis on Independence.

Taken together, the results of the different types of analysis reported in Table 7 establish sizable and statistically significant associations between outcomes and student perceptions of classroom environment and thus attest to the predictive validity of the newly developed Indonesian environment scales. The present results in Indonesia, therefore, replicate much prior research in science classes in developed countries (Fraser & Walberg, 1981) which has established links between students' outcomes and their perceptions of classroom environment.

CONCLUSION

The main purpose of this research was to investigate whether the consistent associations between student outcomes and classroom environment found in past research in developed countries would emerge also in Indonesia. The results the present study revealed the existence of significant relationships between four science-related attitudes and a set of eight classroom environment dimensions among a sample of Indonesian biology students. Consequently the research replicates prior work in developed countries and adds another study to the small list of previous investigations of outcome-environment associations in developing countries (Walberg, Singh & Rasher, 1977; Fraser, 1986d).

Although the study's primary goal was to investigate relationships between Indonesian student attitudes and perceived classroom environment, the development and validation of both classroom environment and attitude instruments suited for use in Indonesia formed an important intermediate step in the research. Because it appears that no Indonesian instrument existed previously to measure either science-related attitudes or classroom environment, the present study's contribution in developing and validating generally applicable instruments should not be underestimated. Data reported in this paper for separate validation and

TABLE 7. Univariate and Multivariate Associations Between Attitudes and Classroom Environment Dimensions

Scale	Inquiry		Adoption		Enjoyment		Leisure	
	r	beta	r	beta	r	beta	r	beta
Personalization	0.15	0.01	0.24*	0.10	0.18	0.00	0.19*	0.01
Participation	0.19*	0.04	0.28**	0.15*	0.28**	0.17*	0.31**	0.21**
Independence	-0.13	-0.10	-0.22*	-0.09	-0.18	-0.15*	-0.26**	-0.20**
Investigation	0.17	0.05	0.23*	0.06	0.15	-0.07	0.19	-0.05
Differentiation	0.06	-0.05	-0.01	-0.01	-0.07	-0.07	-0.05	-0.04
Involvement	0.18	0.04	0.05	-0.10	0.21*	0.10	0.18	0.08
Affiliation	0.13	0.07	-0.02	-0.04	0.08	-0.02	0.13	0.06
Order and Organization	0.21*	0.14*	0.15	0.11	0.23*	0.12	0.16	0.03
Multiple Correlation	0.28*		0.34**		0.34**		0.37**	
Canonical Correlation					0.39**			

* $p<0.05$
** $p<0.01$

crossvalidation samples of Indonesian students attested to the new classroom environment instrument's internal consistency, discriminant validity and ability to differentiate between the perceptions of students in different classrooms, and supported the new science attitude instrument's internal consistency, test-retest reliability and discriminant validity. It is hoped that both researchers and teachers in Indonesia will make use of the newly developed Indonesian versions of science attitude and classroom environment scales to replicate, consolidate and extend the traditions of research and practical applications followed in science education in developed countries.

REFERENCES

ANDERSON, G.J. (1970). Effects of classroom social climate on individual learning. American Educational Research Journal, 7, 135-152.

ANDERSON, G.J. (1971). Effects of course content and teacher sex on the social climate of learning. American Educational Research Journal, 8, 649-663.

ANDERSON, G.J. & WALBERG, H.J. (1968). Classroom climate and group learning. International Journal of Educational Sciences, 2, 175-180.

ANDERSON, G.J. & WALBERG, H.J. (1974). Learning environments. In H.J. Walberg (Ed.), Evaluating Educational Performance: A Sourcebook of Methods, Instruments, and Examples. Berkeley, California: McCutchan.

ANDERSON, G.J., WALBERG, H.J. & WELCH, W.W. (1969). Curriculum effects on the social climate of learning: A new representation of discriminant functions. American Educational Research Journal, 6, 315-327.

CHATIYANONDA, S. (1978). An evaluation of the IPST physics curriculum in Thailand. Unpublished doctoral thesis, Monash University.

CHAVEZ, R.C. (1984). The use of high inference measures to study classroom climates: A review. Review of Educational Research, 54, 237-261.

FISHER, D.L. & FRASER, B.J. (1981). Validity and use of My Class Inventory. Science Education, 65, 145-156.

FISHER, D.L. & FRASER, B.J. (1983). Validity and use of Classroom Environment Scale. Educational Evaluation and Policy Analysis, 5, 261-271. (a)

FISHER, D.L. & FRASER, B.J. (1983). A comparison of actual and preferred classroom environment as perceived by science teachers and students. Journal of Research in Science Teaching, 20, 55-61. (b)

FISHER, D.L. & FRASER, B.J. (1983). Use of Classroom Environment Scale in investigating effects of psychosocial milieu on science students' outcomes. Paper presented at Annual Meeting of National Association for Research in Science Teaching, Dallas. (c)

FRASER, B.J. (1978). Development of a test of science-related attitudes. Science Education, 62, 509-515. (a)

FRASER, B.J. (1978). Environmental factors affecting attitude toward different sources of scientific information. Journal of Research in Science Teaching, 15, 491-497. (b)

FRASER, B.J. (1979). Evaluation of a science-based curriculum. In H.J. Walberg (Ed.), Educational Environments and Effects: Evaluation, Policy, and Productivity. Berkeley, California: McCutchan.

FRASER, B.J. (1981). Learning Environment in Curriculum Evaluation: A Review. Evaluation in Education series, Oxford: Pergamon. (a)

FRASER, B.J. (1981). Using environmental assessments to make better classrooms. Journal of Curriculum Studies, 13, 131-144. (b)

FRASER, B.J. (1981). Predictive validity of an individualized classroom environment questionnaire. Alberta Journal of Educational Research, 27, 240-251. (c)

FRASER, B.J. (1981). Test of Science-Related Attitudes. Melbourne: Australian Council for Educational Research. (d)

FRASER, B.J. (1982). Differences between student and teacher perceptions of actual and preferred classroom learning environment. Educational Evaluation and Policy Analysis, 4, 511-519.

FRASER, B.J. (1984). Differences between preferred and actual classroom environment as perceived by primary students and teachers. British Journal of Educational Psychology, 54, 336-339.

FRASER, B.J. (1985). Two decades of research on classroom psychosocial environment. In B.J. Fraser (Ed.), The Study of Learning Environments 1985. Salem, Oregon: Assessment Research.

FRASER, B.J. (1986). Classroom Environment. London, Croom Helm. (a)

FRASER, B.J. (1986). Individualized Classroom Environment Questionnaire. Melbourne: Australian Council for Educational Research. (in press) (b)

FRASER, B.J. (1986). Determinants of classroom psychosocial environment: A review. Journal of Research in Childhood Education, 1. (in press) (c)

FRASER, B.J. (1986). Effects of classroom climate on student outcomes: A replication in two developing countries. Singapore Journal of Education. (in press) (d)

FRASER, B.J., ANDERSON, G.J. & WALBERG, H.J. (1982). Assessment of Learning Environments: Manual for Learning Environment Inventory (LEI) and My Class Inventory (MCI) (third version). Perth: Western Australian Institute of Technology.

FRASER, B.J. & BUTTS, W.L. (1982). Relationship between perceived levels of classroom individualization and science-related attitudes. Journal of Research in Science Teaching, 19, 143-154.

FRASER, B.J. & FISHER, D.L. (1982). Predicting students' outcomes from their perceptions of classroom psychosocial environment. American Educational Research Journal, 19, 498-518. (a)

FRASER, B.J. & FISHER, D.L. (1982). Predictive validity of My Class Inventory. Studies in Educational Evaluation, 8, 129-140. (b)

FRASER, B.J. & FISHER, D.L. (1983). Assessment of Classroom Psychosocial Environment: Workshop Manual. Research Seminar and Workshop Series, Perth: Western Australian Institute of Technology. (a)

FRASER, B.J. & FISHER, D.L. (1983). Student achievement as a function of person-environment fit: A regression surface analysis. British Journal of Educational Psychology, 53, 89-99. (b)

FRASER, B.J. & FISHER, D.L. (1986). Using short forms of classroom climate instruments to assess and improve classroom psychosocial environment. Journal of Research in Science Teaching. (in press)

FRASER, B.J., NASH, R. & FISHER, D.L. (1983). Anxiety in science classrooms: Its measurement and relationship to classroom environment. Research in Science and Technological Education, 1, 201-208.

FRASER, B.J., PEARSE, R. & AZMI (1982). A study of Indonesian students' perceptions of classroom psychosocial environment. International Review of Education, 28, 337-355.

FRASER, B.J. & WALBERG, H.J. (1981). Psychosocial learning environment in science classrooms: A review of research. Studies in Science Education, 8, 67-92.

GARDNER, P.L. (1976). Attitudes toward physics: Personal and environmental influences. Journal of Research in Science Teaching, 13, 111-125.

HAERTEL, G.D., WALBERG, H.J. & HAERTEL, E.H. (1981). Socio-psychological environments and learning: A quantitative synthesis. British Educational Research Journal, 7, 27-36.

HALADYNA, T., OLSEN, R. & SHAUGHNESSY, J. (1982). Relations of student, teacher and learning environment variables to attitudes toward science. Science Education, 66, 671-687.

HOFSTEIN, A., GLUZMAN, R., BEN-ZVI, R. & SAMUEL, D. (1979). Classroom learning environment and attitudes towards chemistry. Studies in Educational Evaluation, 5, 231-236.

HOFSTEIN, A., GLUZMAN, R., BEN-ZVI, R. & SAMUEL, D. (1980). A comparative study of chemistry students' perceptions of the learning environment in high schools and vocational schools. Journal of Research in Science Teaching, 17, 547-552.

HOLSINGER, D.B. (1972). The elementary school as an early socializer of modern values: A Brazilian study. Unpublished doctoral dissertation, Stanford University.

KELLY, A. (1980). Exploration and authority in science learning environments: An international study. European Journal of Science Education, 2, 161-174.

KLOPFER, L.E. (1971). Evaluation of learning in science. In B.S. Bloom, J.T. Hastings and G.F. Madaus (Eds.), Handbook on Formative and Summative Evaluation of Student Learning. New York: McGraw Hill.

KUERT, W.P. (1979). Curricular structure. In H.J. Walberg (Ed.), Educational Environments and Effects: Evaluation, Policy, and Productivity. Berkeley, California: McCutchan.

LAWRENZ, F. (1976). The prediction of student attitude toward science from student perception of the classroom learning environment. Journal of Research in Science Teaching, 13, 509-515.

MOOS, R.H. (1979). Evaluating Educational Environments: Procedures, Measures, Findings and Policy Implications. San Francisco: Jossey-Bass.

MOOS, R.H. & TRICKETT, E.J. (1974). Classroom Environment Scale Manual. Palo Alto, California: Consulting Psychologists Press.

PAIGE, R.M. (1978). The impact of classroom learning environment on academic achievement and individual modernity in East Java, Indonesia. Unpublished doctoral dissertation, Stanford University.

PERSAUD, G. (1976). School authority pattern and students' social development in selected primary schools in Jamaica. Unpublished doctoral dissertation, Stanford University.

POWER, C.N. & TISHER, R.P. (1979). A self-paced environment. In H.J. Walberg (Ed.), Educational Environments and Effects: Evaluation, Policy, and Productivity. Berkeley, California: McCutchan.

RENTOUL, A.J. & FRASER, B.J. (1979). Conceptualization of enquiry-based or open classrooms learning environments. Journal of Curriculum Studies, 11, 233-245.

RENTOUL, A.J. & FRASER, B.J. (1980). Predicting learning from classroom individualization and actual-preferred congruence. Studies in Educational Evaluation, 6, 265-277.

RIDENG, I. M. & SCHIBECI, R.A. (1984). The development and validation of a test of biology-related attitudes. Research in Science and Technological Education, 2, 21-29.

SOEDIJARTO (1980). Pelaksanaan kurikulum 1975 dan implikasinya bagi penyusunan dan pelaksanaan program penataran tenaga kependidikan (The implementation of the 1975 curricula and its implications for planning inservice training). Analysis Pendidikan, 3, 78-86.

TALTON, E.L. (1983). Peer and classroom influences on attitudes toward science and achievement in science among tenth grade biology students. Paper presented at Annual Meeting of National Association for Research in Science Teaching, Dallas.

TRICKETT, E.J. (1978). Toward a social-ecological conception of adolescent socialization: Normative data on contrasting types of public school classrooms. Child Development, 49, 408-414.

WALBERG, H.J. (1968). Teacher personality and classroom climate. Psychology in the Schools, 5, 163-169.

WALBERG, H.J. (1969). Class size and the social environment of learning. Human Relations, 22, 465-475. (a)

WALBERG, H.J. (1969). Predicting class learning: An approach to the class as a social system. American Educational Research Journal, 6, 529-542. (b)

WALBERG, H.J. (1969). The social environment as mediator of classroom learning. Journal of Educational Psychology, 60, 443-448. (c)

WALBERG, H.J. (1972). Social environment and individual learning: A test of the Bloom model. Journal of Educational Psychology, 63, 69-73.

WALBERG, H.J. (1976). The psychology of learning environments: Behavioral, structural, or perceptual? Review of Research in Education, 4, 142-178.

WALBERG, H.J. (Ed.) (1979). Educational Environments and Effects: Evaluation, Policy, and Productivity. Berkeley, California: McCutchan.

WALBERG, H.J. & ANDERSON, G.J. (1968). Classroom climate and individual learning. Journal of Educational Psychology, 59, 414-419.

WALBERG, H.J. & ANDERSON, G.J. (1972). Properties of the achieving urban class. Journal of Educational Psychology, 63, 381-385.

WALBERG, H.J., SINGH, R. & RASHER, S.P. (1977). Predictive validity of student preceptions: A cross-cultural replication. American Educational Research Journal, 14, 45-49.

WELCH, W.W. (1979). Curricular and longitudinal effects on learning environments. In H.J. Walberg (Ed.), Educational Environments and Effects: Evaluation, Policy, and Productivity. Berkeley, California: McCutchan.

WIERSTRA, R. (1984). A study on classroom environment and on cognitive and affective outcomes of the PLON-curriculum. Studies in Educational Evaluation, 10, 273-282.